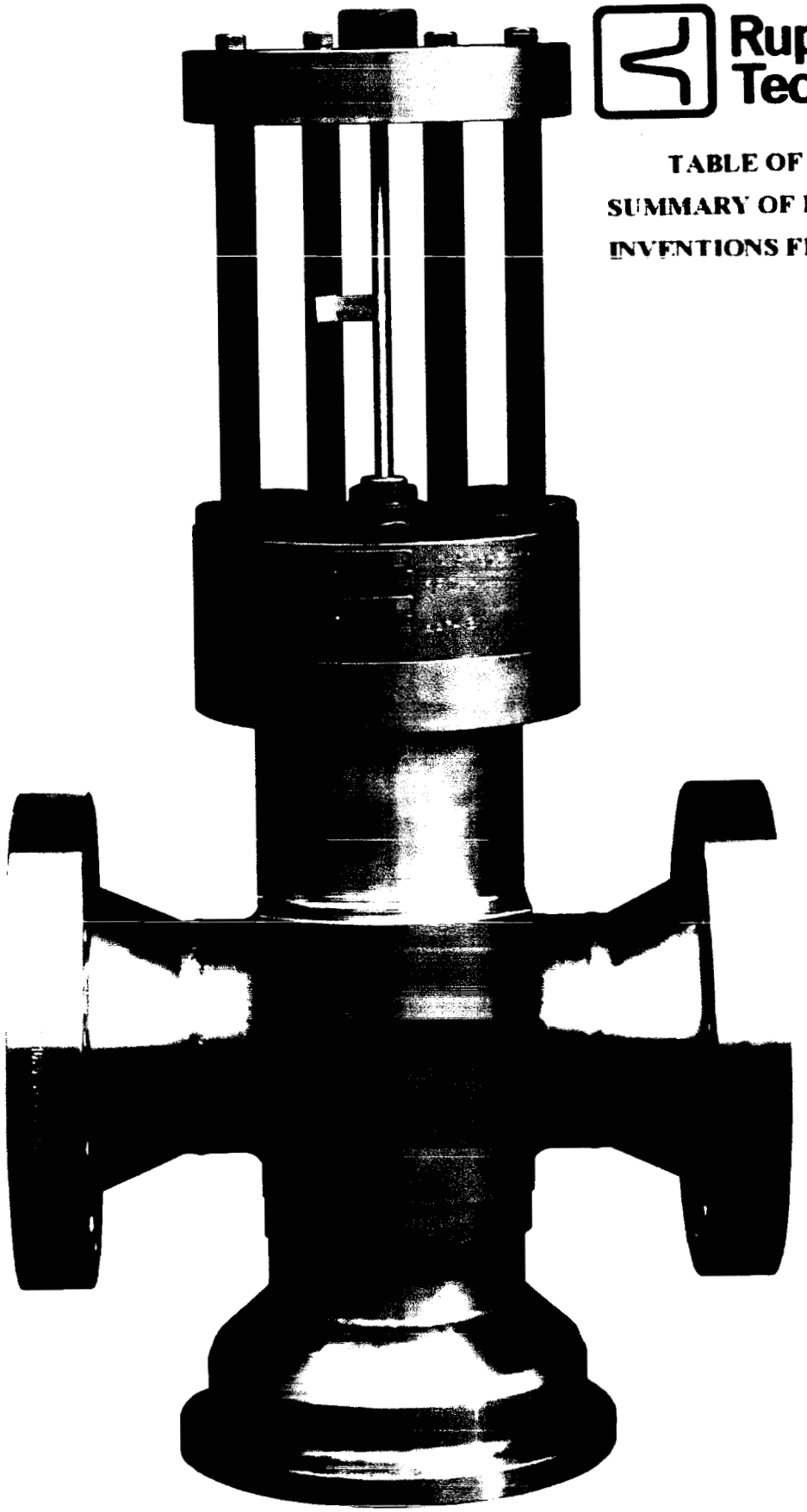

Rupture Pin Technology

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Rupture Pin Technology

NASA COOPERATIVE AGREEMENT NNS04AB34A

SUMMARY OF RESEARCH

Final Report - 8" Reflange inlet and two 6" 600# flange outlets relief valve description and specifications.

Reason for the project: In the past, an Anderson Greenwood (AG) pilot operated relief valve was used to protect the E-1 rocket engine test facility. It was found that the AG valve is destroyed and discharges internal parts at a great velocity on opening. This is a major safety and cost issue.

The solution is a relief valve to match present Anderson Greenwood pilot valve A & B dimensions. The valve is to use a precise buckling pin obeying Euler's Law to act as the pressure sensor and actuator. The valve must not self destruct on opening.

The steps to reach a successful valve design were as follows:

1. August 5, 2004. Mr. Bruce Farner and Mr Haynes Haselmaier Sr. visited the Rupture Pin Technology plant in Oklahoma City. The principal of the Buckling Pin was demonstrated and test procedures reviewed.

2. September 8, 2004. A 2" high pressure valve with a single outlet was tested. The valve was set with water. When the valve was demonstrated November 19, 2004 with high pressure Nitrogen at the Stennis NASA laboratory the valve failed when it opened. The piston hit the internal stop and coined it into the piston, locking it in an open position. We realized that only an air test would give valid results.

3. January 26, 2005. Using a forged body, we built a second 2" valve for a high pressure test in Oklahoma City. For testing, we first charged the test stand with 2500 PSI air and intensified the air to set pressure by pumping water into the base of the test stand. To cushion the rapidly moving piston on opening we put oil at the end of the piston travel. The oil is forced out a 1/8" orifice to slow the piston before reaching the stop. Air test verified this as a solution. In this test series however, failure of piston seals using a wide variety of seals was found to be a design weakness. Another weakness of this design was the extreme reaction force from the valve discharge on opening. This could have been eliminated with a tee at the outlet. This would have been a solution, but could not meet the required A and B dimensions.

4. March 3, 2005. Working with a concept by Mr. Bruce Farner, we redesigned the valve using a forged steel body with one 2" inlet and two 2" inline outlets at 90 degree to the inlet. The piston dead ended into a sealed chamber. The valve worked well with no reaction force, however the piston seal was destroyed with every discharge.

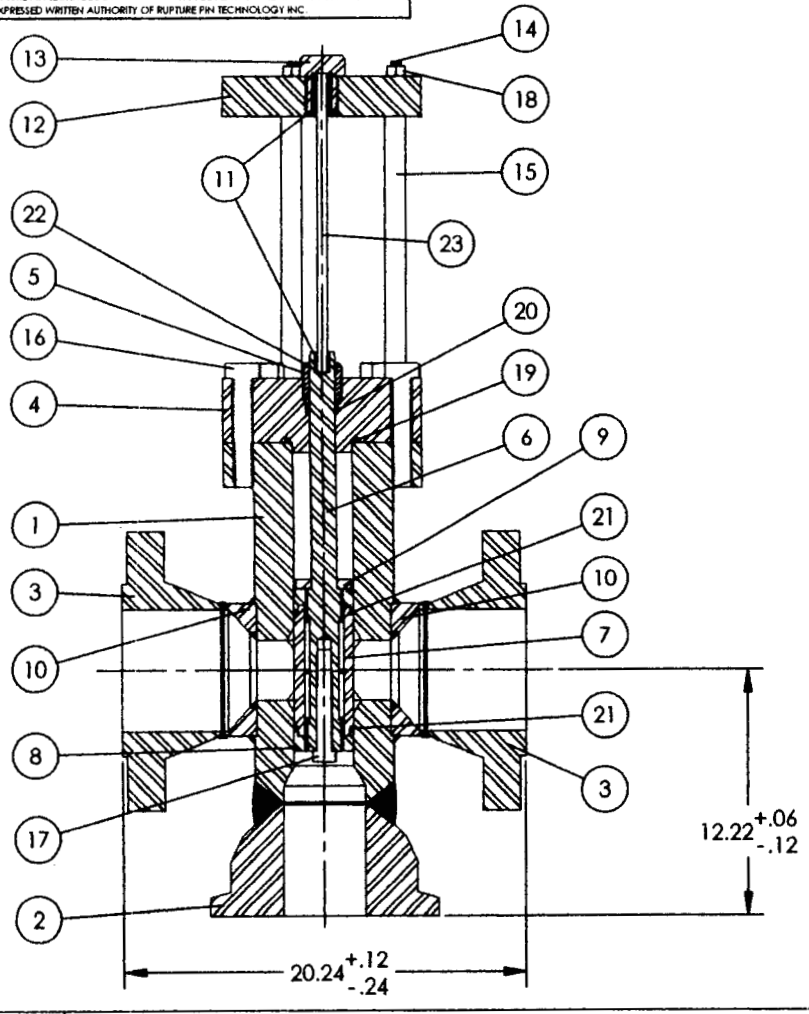
5. May 5 & 6, 2005 To prevent trapped air from trying to reseat the valve Mr. Bruce Farner proposed charging the rod end of the cylinder. This concept was modified with a disc check valve on the piston. It was felt that for the NASA application changing seals after each opening would not be a major design weakness. The advantage would be that the valve could be designed to the exact dimensions of the AG valve using the same inlet and outlet connections. After design approval the final design was made, using 316 SS construction with a 17-4 SS piston to prevent galling and a 9D aluminum bronze piston stem seal cap. The valve was designed to accommodate two pressure settings 8,100 PSI and 9,000 PSI. This was done by changing the pin length using two spacer sets, red spacers for the high setting and blue spacers for the lower setting. The valve worked well and the design was finalized. Test still showed that to be completely successful the seal problem must be solved. We have contacted over five seal manufacturers but have found none willing to make special designs to solve our problem if it is not in their product line due to our limited market. Two suppliers will machine Teflon seals to our prints. Rupture Pin Technology Inc. can solve the seal problem by trying new seal designs and air testing.

Rupture Pin Technology

NASA COOPERATIVE AGREEMENT NNS04AB34A

SUBJECT : INVENTIONS FINAL REPORT

The basic design feature of partially balancing the inlet pressure by applying inlet pressure above the piston on the rod end so the axial force on the pin is equal to the upstream pressure times the stem area is not covered exactly by US patent numbers 5,273,065; 5,297,575 or 5,348,039. However this balance method has been used extensively in the past see print 87-006021. The use of the check valve seal disc on the piston, (see final assembly drawing 87-057304 item #9) whether biased by gravity or a light spring to a closed position to present a restricted pathway for air trapped behind the piston on opening, to cushion the piston, may be unique. It is expected that a unique seal solution for the piston seal problem when found, would be a patentable design since presently available design solutions have failed.



ITEM #	PART	QTY	DWG #	DESCRIPTION
1	BODY	1	87-007361	TYPE 316 SS TO SA479
2	INLET FLANGE	1	87-007384	REFLANGE T-CON P/N TF08-061-208V
3	OUTLET FLANGE	2	N/A	6 ANSI 600# RFWN FLANGE, TYPE 316 SS TO SA182
4	BONNET	1	87-007362	TYPE 316 SS TO SA479
5	GLAND BUSHING	1	87-007371	TYPE 9D ALUMINUM BRONZE TO SB150
6	PISTON - SHAFT END	1	87-007366	TYPE 17-4PH SS TO SA564 COND. H900
7	PISTON SHELL	1	87-007367	TYPE 17-4PH SS TO SA564 COND. H900
8	PISTON BASE	1	87-007368	TYPE 17-4PH SS TO SA564 COND. H900
9	SEAL DISC	1	87-007365	TYPE 9D ALUMINUM BRONZE TO SB150
10	OUTLET ADAPTER	1	87-007406	TYPE 316 SS TO SA479
11	TAPERED INSERT	2	87-007364	TYPE 17-4PH SS TO SA564 COND. H900
12	TOP PLATE	1	87-007218	TYPE 316 SS TO SA479
13	HOLDING NUT	1	87-002312	TYPE 17-4PH SS TO SA564 COND. H900
14	POST	4	N/A	1/2-13UNC-2A ALL THREAD, TYPE 18-8 SS
15	SPACER	4	N/A	1 X 0.250 TUBING, TYPE TP316 SS TO SA249
16	HEX BOLT (BONNET)	8	N/A	1-8UNC-2A X 5-1/2 LONG, TYPE 304 SS TO SA320 B8 CLASS 2
17	HEX BOLT (PISTON)	1	N/A	3/4-10UNC-2A X 5 LONG, TYPE 18-8 SS
18	HEX NUT (POST)	4	N/A	1/2-13UNC-2B, TYPE 18-8 SS
19	O-RING (BONNET)	1	N/A	2-339, VIRGIN TEFLON
20	O-RING (STEM)	1	N/A	2-322, VIRGIN TEFLON
21	O-RING (PISTON)	2	N/A	2-334, VIRGIN TEFLON
22	SNAP RING	1	N/A	5100-0125, TYPE 15-7 SS
23	RUPTURE PIN	1+3	N/A	PROPRIETARY ALLOY

DESIGN TEMPERATURE	:	-450°F TO 100°F
DESIGN PRESSURE	:	14500 PSIG
NDE	:	NONE
MAX. SET PRESSURE	:	9000 PSIG +/- 5%
HYDRO PRESSURE	:	15,000 PSIG

MANUFACTURED TO ASME SECT. VIII, DIV. I PARA. UG-127 - UG-136
MATERIAL BASED ON PARA. UG-136(b) OR CODE CASE 1750

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CUSTOMER	:	STENNIS SPACE CENTER
CUST PO#	:	4200068386
SERIAL	:	9374A
PIN CODE #	:	5000-14193-100-4-3
SET PRESSURE	:	8100 PSIG +/-3%

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CUST PO#	:	4200068386
SERIAL	:	9374B
PIN CODE #	:	5000-11981-100-4-3
SET PRESSURE	:	9000 PSIG +/-3%

PART NO.	MATERIAL DESCRIPTION
	STAINLESS STEEL ASSEMBLY

DOCUMENT CONTROL			
5-09-05	RELEASED	JA	A
DATE	ECN NO.	APPR.	REV.

RUPTURE PIN™ TECHNOLOGY INC. 8230 SW 8th Oklahoma City, Oklahoma 73128 (405)789.1884 FAX (405)789.1942

8" NASA MODEL 'I' HIGH PRESSURE RELIEF VALVE-DUAL OUTLET

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ARE:
CORNERS: .03 X 45°
RADII: .03
STAMPING TO BE: LOW STRESS TYPE
HARDNESS TEST LOCATION WHEN REQUIRED FOR FACE

	DECIMALS	.X	.XX	.XXX
	TOLERANCE	±.1	±.02	±.005
	SURF FINISH	500	250	125
	ANGULAR	±1/2°		

DO NOT SCALE DRAWING
CAD GENERATED DRAWING.DO NOT MANUAL.Y UPDATE

APPROVALS	DATE
DRAWN J AKINS	5-09-05
CHECKED	
APPROVED J TAYLOR	5-09-05
CAD FILE 007304-A	REV.
DWG. NO. 87-057304	A

US005273065A

United States Patent [19]

Taylor

[11] Patent Number: 5,273,065

[45] Date of Patent: Dec. 28, 1993

[54] **LARGE DIAMETER AND RELATIVELY HIGH PRESSURE RELIEF VALVE**

[76] Inventor: **Julian S. Taylor**, 8300 SW. 8th, Oklahoma City, Okla. 73128

[21] Appl. No.: **35,766**

[22] Filed: **Mar. 23, 1993**

[51] **Int. Cl.**[5] **F16K 17/14**

[52] **U.S. Cl.** **137/70**; 137/494

[58] **Field of Search** 251/282; 137/68.1, 70, 137/71, 494, 509

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,724,657	2/1988	Taylor	137/70 X
4,936,714	6/1990	Demicray	137/494 X
5,012,834	5/1991	Taylor	137/70

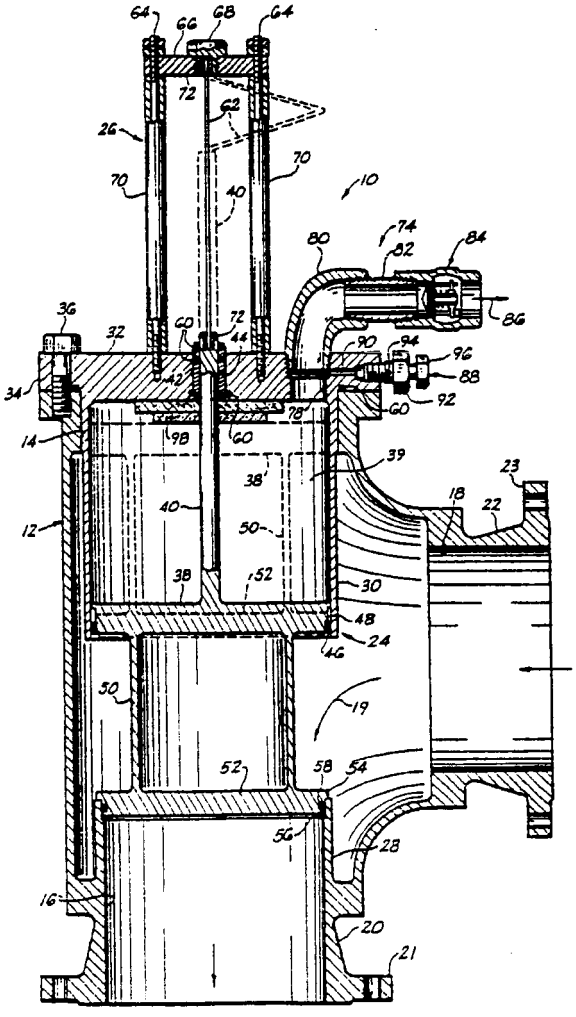
Primary Examiner—John C. Fox

Attorney, Agent, or Firm—Robert K. Rhea

[57] **ABSTRACT**

A pressure relief valve for monitoring pressure in relatively large diameter conductors containing relatively high fluid pressure. The valve having housing openings of equal diameter with respect to the conductor and a flow passageway is provided with different diameter coaxial sleeves slidably receiving dual diameter interconnected pistons. The smaller diameter piston forms a flow passageway stop while the larger diameter piston generates a pressure differential with respect to the smaller diameter piston for moving both pistons toward a flow passageway open position in which a piston rod guides the pistons in their axial movement with respect to the sleeves and collapses a pressure collapsible pin supported by a pin cage connected with the valve body in axial alignment with the piston rod for opening the valve passageway and releasing fluid pressure from the conductor.

10 Claims, 2 Drawing Sheets



US005297575A

United States Patent [19]

Taylor

[11] Patent Number: 5,297,575

[45] Date of Patent: Mar. 29, 1994

[54] **IN-LINE HIGH PRESSURE FLUID RELEASE VALVE**

[76] Inventor: **Julian S. Taylor**, 8300 SW. 8th, Oklahoma City, Okla. 73128

[21] Appl. No.: **99,380**

[22] Filed: **Jul. 30, 1993**

[51] **Int. Cl.**[5] **F16K 17/14**

[52] **U.S. Cl.** **137/70**; 137/467

[58] **Field of Search** 137/67, 68.1, 70, 71, 137/461, 467; 251/282

[56] **References Cited**

U.S. PATENT DOCUMENTS

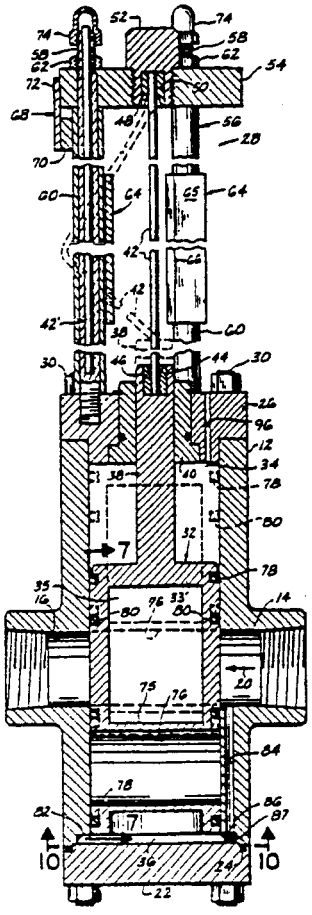
2,912,992	11/1959	Gasche et al.	137/70
3,323,531	6/1967	Spellman	137/68.1
3,476,133	11/1969	Stedfeld	137/467 X
4,587,987	5/1986	West	137/71 X
4,724,857	2/1988	Taylor	137/67
5,012,834	5/1991	Taylor	137/70
5,067,511	11/1991	Taylor	137/67

Primary Examiner—Martin P. Schwadron
Assistant Examiner—Kevin L. Lee
Attorney, Agent, or Firm—Robert K. Rhea

[57] **ABSTRACT**

An in-line high pressure fluid release valve is formed by a valve body having a cylinder and having a transverse opening forming a fluid passageway interposed in a fluid conductor. A piston normally closing the fluid passageway and having a fluid passageway size transverse opening is guided to prevent angular rotation during longitudinal sliding movement in the cylinder by a piston rod and a cylinder wall supported guide rod projecting into a piston wall slot for mating and mismating the piston opening with the flow passageway. A pin cage connected with the piston rod end of the cylinder axially supports a collapsible pin normally biasing the piston to a fluid passageway closed position until upstream fluid pressure of a predetermined value channeled through a cylinder wall fluid bypass at the piston end opposite the piston rod to bias the piston toward a passageway open position for releasing fluid pressure downstream. A fluid bypass check valve holds fluid under pressure in the piston cavity and against the piston end opposite its rod to insure full travel of the piston for axially aligning its opening with the fluid passageway.

10 Claims, 2 Drawing Sheets



US005348039A

United States Patent [19]

Taylor et al.

[11] Patent Number: 5,348,039

[45] Date of Patent: Sep. 20, 1994

[54] LARGE DIAMETER AND RELATIVELY HIGH PRESSURE RELIEF VALVE

[75] Inventors: Julian S. Taylor, 8300 SW. 8th St., Oklahoma City, Okla. 73128; C. Dean Couch, Oklahoma City, Okla.

[73] Assignee: Julian S. Taylor, Oklahoma City, Okla.

[21] Appl. No.: 169,242

[22] Filed: Dec. 20, 1993

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 35,766, Mar. 23, 1993, Pat. No. 5,273,065.

[51] Int. Cl.[5] F16K 17/40

[52] U.S. Cl. 137/70; 251/282

[58] Field of Search 251/282; 137/68.1, 70, 137/71, 494, 509

[56] References Cited

U.S. PATENT DOCUMENTS

5,193,575 3/1993 Do 137/509

5,271,428 12/1993 Dunn et al. 137/509

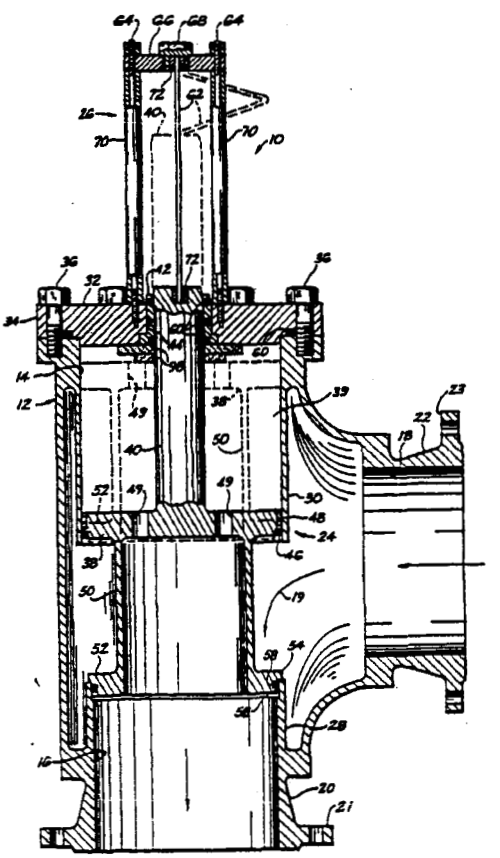
Primary Examiner—John C. Fox

Attorney, Agent, or Firm—Robert K. Rhea

[57] ABSTRACT

A pressure relief valve for monitoring pressure in relatively large diameter conductors containing relatively high fluid pressure. The valve having housing openings of equal diameter with respect to the conductor and a flow passageway provided with different diameter coaxial sleeves slidably receiving interconnected dual diameter pistons. The smaller diameter piston forms a flow passageway stop while the larger diameter piston generates a pressure differential with respect to the smaller diameter piston for moving both pistons toward a flow passageway open position in which a piston rod guides the pistons in their axial movement with respect to the sleeves and collapses a pressure collapsible pin supported by a pin cage connected with the valve body in axial alignment with the piston rod for opening the valve passageway and releasing fluid pressure from the conductor. The larger diameter piston is apertured to admit downstream fluid pressure to its low pressure side. The piston rod diameter is selected to equal the difference in cross sectional area of the piston surfaces exposed to downstream fluid thereby completely balancing the pistons with respect to downstream fluid pressure.

15 Claims, 2 Drawing Sheets



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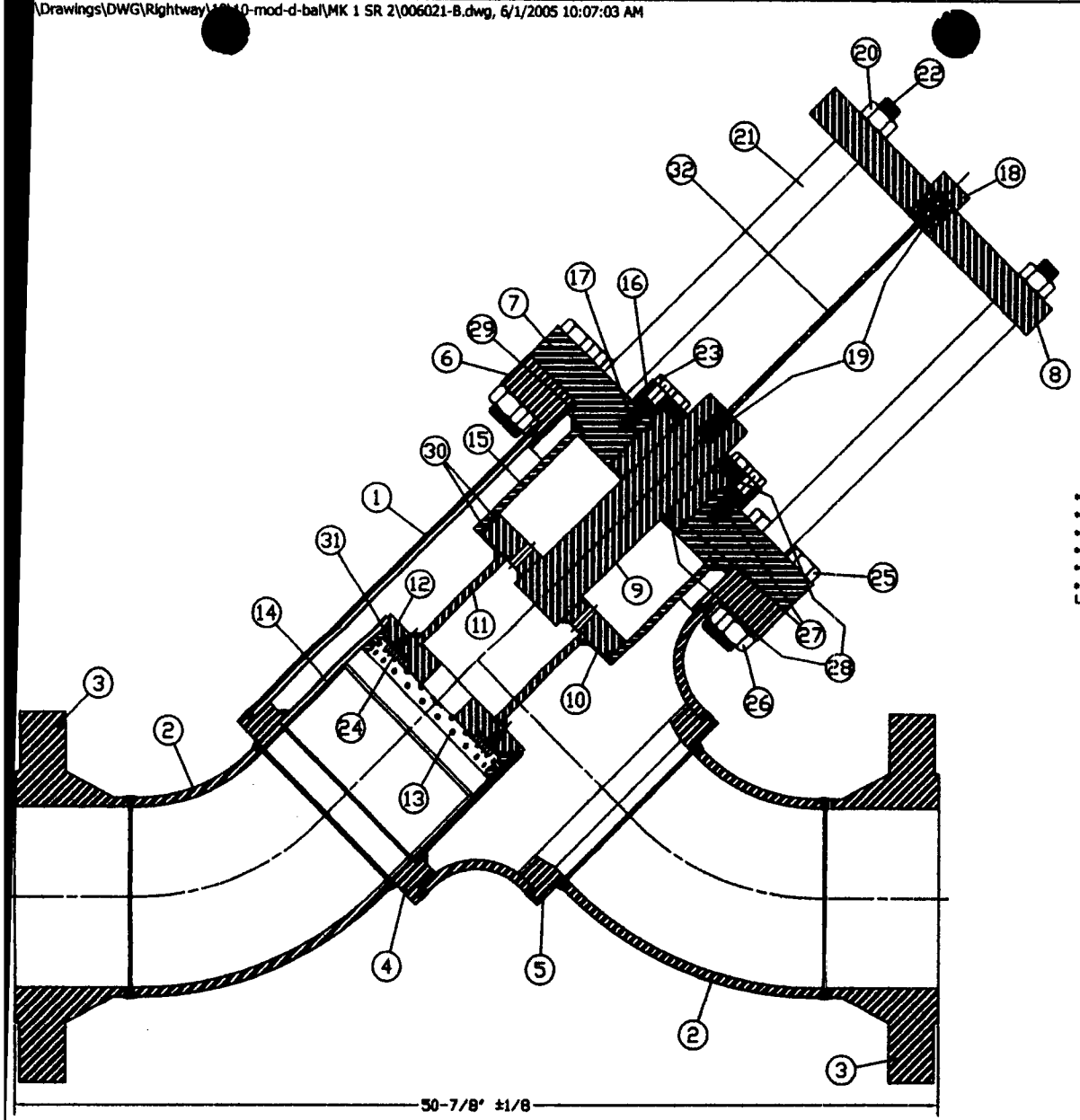

ITEM #	PART	QTY	DWG #	DESCRIPTION
1	WELD TEE	1	N/A	14" XH WELD TEE, CARBON STEEL TO SA516-70
2	IN/OUT ELBOW	2	N/A	10" XH WELD ELL, CARBON STEEL TO SA516-70
3	IN/OUT FLANGE	2	N/A	10" ANSI 600# FLANGE, XH BORE, C.S. TO SA105
4	INLET PLATE	1	87-006591	CARBON STEEL TO SA516-70
5	OUTLET PLATE	1	87-006592	CARBON STEEL TO SA516-70
6	END FLANGE	1	87-006022	CARBON STEEL TO SA516-70
7	BONNET	1	87-006023	CARBON STEEL TO SA516-70
8	TOP PLATE	1	87-006024	CARBON STEEL TO SA516-70
9	PISTON STEM	1	87-006027	TYPE 17-4 SS TO SA564, COND. H900
10	BALANCE PISTON	1	87-006026	TYPE 316 SS TO SA479
11	PISTON SPACER	1	87-006025	6" SCH 80 PIPE, TYPE 316 SS TO SA312
12	MAIN PISTON	1	87-006008	TYPE 316 SS TO SA479
13	SEAL RETAINER	1	87-006007	TYPE 316 SS TO SA479
14	SEAT TUBE	1	87-005593	10" XH PIPE, TYPE 316 SS TO SA312
15	BALANCE SEAT	1	87-005594	10" SCH. 80 PIPE, TYPE 316 SS TO SA312
16	BUSHING RETAINER	1	87-006028	1018/1020 CARBON STEEL TO A108
17	GLAND BUSHING	1	87-006037	ALUMINUM BRONZE TO SB150
18	HOLDING NUT	1	N/A	TYPE 17-4 SS TO SA564, COND. H900
19	TAPERED INSERT	2	N/A	TYPE 17-4 SS TO SA564, COND. H900
20	HEX NUT (POST)	3	N/A	1 1/4"-7NC-2B, TYPE 18-8 SS
21	SPACER	3	N/A	1-3/4 O.D. x 1-1/4 I.D. TUBING TYPE 316 SS TO SA312
22	POST	3	N/A	1-1/4"-7UNC-2A ALL THREAD, S7
23	HEX BOLT (RETAIN.)	8	N/A	3/4"-10NC-2A x 2-1/2" LONG, TYPE 18-8 SS
24	HEX BOLT (SEAL)	8	N/A	1/2-13NC-2A x 1" LONG, TYPE 18-8 SS
25	HEX BOLT (BONNET)	16	N/A	1 1/4-7NC-2A x [illegible]" LONG, TYPE 18-8 SS
26	HEX NUT (BONNET)	16	N/A	1 1/4-7NC-2B, TYPE 18-8 SS
27	O-RING (BUSHING)	2	N/A	2-352, VITON 90 DURO
28	O-RING (STEM)	2	N/A	2-337, VITON 90 DURO
29	O-RING (BONNET)	1	N/A	2-381, VITON 90 DURO
30	O-RING (BAL PSTN)	2	N/A	2-375, VITON 90 DURO
31	O-RING (PISTON)	1	N/A	2-445, VITON 90 DURO
32	RUPTURE PIN	1+3	N/A	ALLOY #1

RECOMMENDED SPARE PARTS

RPTI SO#	:	NOT ESTABLISHED
CUSTOMER	:	NOT ESTABLISHED
CUST PO#	:	NOT ESTABLISHED
SERIAL #	:	NOT ESTABLISHED
PIN CODE#	:	NOT ESTABLISHED
SET PRESSURE	:	NOT ESTABLISHED

DOCUMENT CONTROL

DATE	ECN NO.	APPR.	REV.
7-19-01	0123	JA	B
7-19-01	RELEASED		1

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE TO BE:
FRACTIONS ±1/64
.XX ±.010
.XXX ±.005
ANGULAR ±1°
CORNERS .03 x 45°
RADII .03 R
CONCENTRICITY .010 T.I.R.
FINISH 63 RMS

STAMPING TO BE LOW STRESS TYPE

HARDNESS TEST LOCATION

RUPTURE PIN™ TECHNOLOGY INC.

SCALE: NONE	APPROVED BY: J TAYLOR	DRAWN BY: S CALDWELL
DATE: 7-19-01		

10" MODEL 'D' BALANCED – HIGH PRESSURE

GENERAL ASSEMBLY

DRAWING NUMBER: 87-006021